Amendments to the Specification:

Please replace the paragraph beginning at page 1, line 1 with the following amended paragraph:

This application is a continuation-in-part of U.S. application serial no. 09/258,160 filed February 25, 1999, now U.S. Patent No. 6,278,847 which claims the benefit of U.S. provisional application serial no. 60/078,750, filed on February 25, 1998.

Please replace the paragraph beginning at page 2, line 2 with the following amended paragraph:

Figure 1A shows a large aperture or small f stop is used. This obtains more light from the scene, but leads to a small depth of field. The small depth of field can lead to blurring of the image. A smaller ~~F~~ f stop increases the depth of field as shown in Figure 1B. Less image blurring would therefore be expected. However, less light is obtained.

Please replace the paragraph beginning at page 9, line 24 with the following amended paragraph:

Figure 4A shows a drawing of the preferred camera;

Please replace the paragraph beginning at page 9, line 25 with the following amended paragraph:

Figure 5 and 6 shows more detailed drawings of the optical relays of the camera shown in Figure 4A.

Please replace the paragraph beginning at page 9, line 27 with the following amended paragraph:

~~FIG~~ Figure 7 is a schematic perspective view of the previously disclosed three-dimensional system, where one single lens is used with a three-aperture mask and a set of three separated cameras, each of which is associated with one aperture.

Please replace the paragraph beginning at page 10, line 1 with the following amended paragraph:

~~FIG~~ Figure 8 is a schematic perspective view of the present invention where 3 lens-aperture sets are used in combination with a set of three separated cameras, each of which is associated to one lens-aperture set. The drawing shows how the

pattern defined by the geometry of the lens-aperture system (an equilateral triangle in this case) changes with the position in space of the corresponding source point.

Please replace the paragraph beginning at page 10, line 8 with the following amended paragraph:

~~FIG~~ Figure 9 is geometrical model of the present invention, using the 2-aperture arrangement for sake of clarity, and displaying all the parameters defining the optical principle of defocusing and upon which the present invention will be described in the following sections. The same parameters apply to a system with more than 2 lens-aperture systems.

Please replace the paragraph beginning at page 10, line 14 with the following amended paragraph:

~~FIG~~ Figure 10 is a flow diagram showing the sequence of program routines forming DE2PIV and used in the preprocessing of the combined images provided by a system with 3 lens-aperture sets.

Please replace the paragraph beginning at page 10, line 18 with the following amended paragraph:

~~FIG~~ Figure 11 is a flow diagram showing the sequence of program routines forming FINDPART and used in the image processing of the preprocessed images provided by DE2PIV. The program determines the three-dimensional coordinates of the scattering sources randomly distributed within a volume or on a surface.

Please replace the paragraph beginning at page 10, line 23 with the following amended paragraph:

~~FIG~~ Figure 12 is a flow diagram showing the sequence of program routines forming FILTERPART and used in the processing of the results provided by FINDPART. Operations such as volume-of-interest, source characterization, 3D geometrical operations, are possible.

Please replace the paragraph beginning at page 10, line 28 with the following amended paragraph:

~~FIG~~ 13 Figure is a flow diagram showing the sequence of program routines forming FINDFLOW and used in the processing of the results provided by FILTERPART. The program calculates the 3D displacement of the scattering sources as a function of time, i.e. the 3D velocity.

Please replace the paragraph beginning at page 11, line 1 with the following amended paragraph:

~~FIG~~ Figure 14 is a flow diagram showing the sequence of program routines forming FILTERFLOW and used in the processing of the results provided by FINDFLOW. The program validates the results and outputs the data to various standard formats. Every dataset of scattering sources is characterized by a 3D vector field comprising the 3D coordinates of every source, the 3D velocity.

Please replace the paragraph beginning at page 11, line 8 with the following amended paragraph:

Figure 2 shows a geometric analysis in which a camera lens of focal length ~~F~~ f is located at z=0. Two small apertures are placed within the lens, separated a distance d/2 away from the optical centerline 200 which also corresponds to the z axis. The apertures are shown as pinholes in this diagram to simplify the model. The theory for larger and more complex apertures would be similar.

Please replace the paragraph beginning at page 13, line 12 with the following amended paragraph:

Light is input through mask 342, which includes an opaque aperture plate with three apertures formed therein. In this embodiment, the apertures are generally in the shape of a triangle. The light passes to a lens assembly ~~346~~ 340, which directs the light into the chamber that houses the camera.

Please replace the paragraph beginning at page 14, line 16 with the following amended paragraph:

A second embodiment separates the images from the different apertures using rapid sequential imaging. An embodiment is shown in Figure 4. A scene is imaged through a mask 400 that includes multiple apertures. Each aperture has an associated selective blocking means 402. The blocking means is a device that either allows light to pass through the aperture or blocks light from passing through the aperture under control of an applied control signal 404 from a control element ~~400~~ 406. The aperture blocking means 402 can be a mechanical blocker e.g. a mechanical shutter, solid state optics, such as a liquid crystal which is selectively allowed to pass light, or a digital mirror which selectively reflects the light to the aperture or the like. Light from the scattering sites ~~410~~ is allowed to pass through each aperture at a separate time, under control of the controller 406. The passed light is sent to a single camera 430

that produces an image indicative of the passed light. Three different images are obtained at three different times. Each image is based on passage of the light through a different aperture.

Please replace the paragraph beginning at page 15, line 12 with the following amended paragraph:

Another embodiment uses spacial filters to separate the different light values. Figure 5 shows a preferred configuration of a spatially coded camera. The system includes a focusing lens assembly 500, 504, with an aperture system 506 between the two portions of the focusing lens 500, 504. An exploded view of the components is shown in Figure 6. Each of the prisms e.g. 510~~, 512, 514~~ is directly located behind each aperture orifice. A three CCD camera 520 views the three images through the three aperture orifices, thereby providing three simultaneous views of the image.

Please replace the paragraph beginning at page 16, line 19 with the following amended paragraph:

In the figure 7 implementation, three prisms 730,~~730 to~~ 732, 734 are used to redirect the light away from the optical axis of the camera. This may simplify the design.

Please replace the paragraph beginning at page 16, line 22 with the following amended paragraph:

Another design is shown in figure 8A. The camera in figure 8A is redesigned so that each photo sensor 804 has its own lens-aperture system 801, 802. Still, however, the global optical axis ~~805~~ of the camera is preserved and is unique. The system behaves as if we had replaced the original lens by a lens with infinite focal length. The use of small lenses 802 in front or behind the apertures 801 may also improve the collection of light as to produce small images on the imaging sensors 805, which allows the use of variable apertures and therefore allows to work in a wide range of lighting conditions. The flexibility of this lens assembly allows for more accurate 3D imaging, as no complex optics are used, thus minimizing the optical imperfections, making the manufacturing easier and the system ruggedized for field applications where environmental concerns are an important factor. Moreover, the geometrical parameters can be freely modified to match the specific requirements of the application, such as size of volume, depth resolution, etc

Please replace the paragraph beginning at page 17, line 11 with the following amended paragraph:

The present embodiment preserves the same geometrical information as in the original design. In this arrangement, the 3 imaging sensors are arranged so that they form an equilateral triangle. Figures 8A and 8B ~~shows~~ show how a point A placed on the reference plane 803 is imaged as one unique image 807 on the combined imaged 806. Points B and C placed in between the lens-aperture plane and the reference plane will image as equilateral triangles 808 and 809, respectively. This is due to the fact that the 3 imaging sensors were arranged to form an equilateral triangle, thereby resulting in the equilateral triangles shown by 808 and 809. The size and the centroid of such triangles are directly related to the depth and plane location of the corresponding source point, respectively. It is understood that there would be such triangle patterns for any source point, each of them uniquely identifiable, making the invention suitable for the instantaneous mapping of large number of points, and consecutively suitable for real-time imaging of such sets at a frame rate defined either by the recording capabilities or by the dynamical system under observation. It is important to note that the arrangement of the 3 imaging sensors in the form of an equilateral triangle is not unique, and that any identifiable pattern could have been chosen.

Please replace the paragraph beginning at page 17, line 34 with the following amended paragraph:

This present ~~invention~~ embodiment allows for the 3 separate sensor/lens assemblies to be movable while maintaining the same geometric shape. For example, if the 3 sensor/lens sets are arranged so that they outline an equilateral triangle of a certain size, the 3 sensor/lens assemblies can be moved, thus allowing for visualizing smaller or larger volumes, in a manner that will preserve the equilateral triangle in their outline. Furthermore, the lens/pinhole assembly will be interchangeable to allow for imaging of various volume sizes. Such features will also allow the user to vary the working distance at their convenience.

Please replace the paragraph beginning at page 19, line 1 with the following amended paragraph:

~~The invention will be presented in terms of the simplest implementation, which makes use of~~ Figure 9 illustrates a 2 lens-aperture ~~sets~~ set. For this purpose, a simplified geometric model of a two-aperture defocusing optical arrangement is represented in FIG 3. The interrogation domain is defined by a cube of side a. The back face of this cube is on the reference plane, which is placed at a distance L from the lens plane. The

image plane is materialized by a photo sensor (e.g. CCD) of height h. Let d be the distance between apertures, f the focal length of the converging lens and l the distance from the lens to the image plane. The physical space is attached to a coordinate system originating in the lens plane, with the Z-axis on the optical axis of the system. Coordinates in the physical space are designated (X,Y,Z). The image coordinate system is simply the Z-translation of the physical system onto the sensor plane, i.e. at Z=-l. The coordinates of a pixel on the imaging sensor are given by the pair (x, y). Point P(X,Y,Z) represents a light scattering source. For Z<L, P is projected onto points P1(x'1,y'1) and P2(x'2,y'2), such that

Please replace the paragraph beginning at page 20, line 18 with the following amended paragraph:

The image and information that is obtained from this system may be processed as shown in the flowcharts of figures 10-14. In figure 10, step 1000 defines reading in three images from the three CCD cameras of any of the previous embodiments. At 1010, preprocessing parameters may be set up which may be used for noise processing, and background image removal. Particle peaks are identified at 1020. These particle peaks may be identified by locally identifying peaks, building a particle around each

peak, and then accounting for particle overlap. In this way, preprocessed peaks are obtained at 1030, with the particle peaks being highlighted.

Please replace the paragraph beginning at page 21, line 15 with the following amended paragraph:

In figure 12, the ~~thsu~~ thus obtained results are further processed at ~~1202~~ 1200 identify the volume of interest, to translate the data set, and to rotate the data set. A radius is determined at 1210 based on intensity as input from the calibration data set and the scattering formulation. The size related terms determined at 1220 such as size histograms and void fraction. At 1230, an output particle data field is obtained within the constraints given in the input parameter file.